

## Noteworthy Lichens with Mazaedia Collected in Cambodia

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Two lichen species with mazaedia are reported from Cambodia. *Pyrgillus cambodiensis* Kashiw., K. H. Moon & Aptroot is described as new to science. It is distinct from *P. javanicus* Nyl., another species of the genus widely distributed in tropical and subtropical areas in the world, in having anthraquinones on the margin of the ascomata and lacking lichexanthone in the thallus. *Tylophoron moderatum* Nyl. is reported from Cambodia for the first time.

**Key words:** Cambodia, lichen, *Pyrgillus cambodiensis*, *Tylophoron moderatum*.

The lichen flora of Cambodia is poorly known. Kashiwadani, Moon and Futagami had a chance to do lichenological fieldwork at Siem Reap, Cambodia. It was carried out as a part of the Joint Research Project on Conservation of Stone at Ta Nei Temple, Siem Reap, supported by the National Research Institute for Cultural Properties, Tokyo from 2005 to 2011. During the survey we collected more than 500 lichen specimens around Angkor temples in Siem Reap. Thirteen species of *Graphidaceae* have been reported as a part of the taxonomic study of the collections by the present authors (Kashiwadani 2008, Moon et al. 2011, Nakanishi et al. 2010). Among the collections, however, we recently found two interesting species with mazaedia, which are found to be interesting

phytogeographically and taxonomically. In the present paper, *Pyrgillus cambodiensis* Kashiw., K. H. Moon & Aptroot and *Tylophoron moderatum* Nyl. are reported to be endemic to or distributed in Cambodia.

### Materials and Methods

Kashiwadani and Moon collected the specimens used for the present study in 2005 and 2011 around the temples of Angkor, Siem Reap in Cambodia. They are kept in the herbarium of the National Museum of Nature and Science (TNS) unless otherwise cited. Chemical substances were studied by means of thin-layer chromatography (Culberson and Johnson 1982). Sections of apothecia and thalli were cut by hand-razor and mounted in GAW solution.

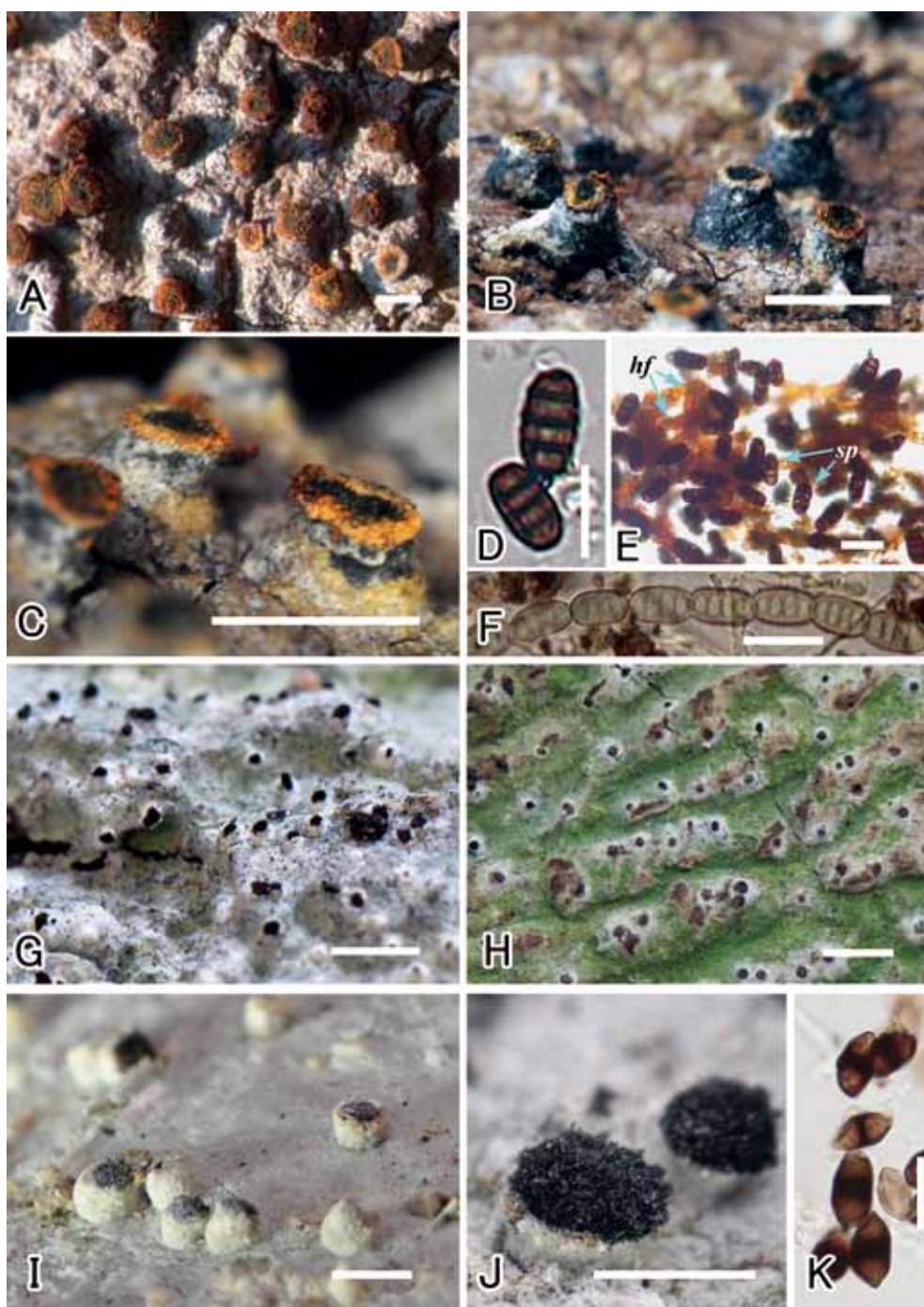


Fig. 1. A–F. *Pyrgillus cambodiensis* Kashiw., K. H. Moon & Aptroot. A–C. Habit showing conical ascocarps with orange-red pruina. D. Mature ascospores. E. Spores (sp) and yellow fragment of hyphae (hf) found in mazaedia. F. Ascus with uniseriate 8 ascospores (immature stage). G–K. *Tyrophoron moderatum* Nyl. G–H. Habit showing continuous whitish gray thallus (G) and discontinuous greenish yellow thallus (H). I. Shortly cylindrical ascocarps. J. Mazaedia projecting beyond the margin. K. Spore. Scale bars = 1 mm (A, B, C, G, H, I, J) and 10 µm (D, E, F, K).

### Taxonomic treatment

1) *Pyrgillus cambodiensis* Kashiw., K. H. Moon & Aptroot, sp. nov. [Fig. 1, A–F]

Thallus crustose, pale brown to yellowish brown, dull, coarsely rimose; thallus uneven in thickness, lacking cortex, medulla composed of a mass of conglutinate hyphae, *Trentepohlia* gonidia and crystals of calcium oxalate, 30–80  $\mu\text{m}$  thick. Ascocarps dispersed, erumpent, conical and terminally truncated, black, almost naked on the upper half, immersed in the thallus at base, 0.6–0.8 mm in diameter at basal portion, 0.4–0.5 mm in diameter at apex, 1.5–2 mm high. Ascocarps mazaedioid; mazaedia blackish brown, composed of ascospores and orange-yellow fractions of hyphae; ostioles orange-red (K+ purple) at margin; exciple black, well developed, completely carbonized, 250–350  $\mu\text{m}$  thick, thickened in the middle; hamathecium colourless, clear and not interspersed, I –, connecting above to the mazaedia; asci cylindrical, 65  $\times$  5–6  $\mu\text{m}$ , 8-spored, uniseriate; ascospores dark brown, 4-celled with distosepta, broadly ellipsoid, 10–12  $\times$  5–7  $\mu\text{m}$ .

Chemistry: Orange-red pigments of anthraquinone series.

**Type collection:** CAMBODIA. Prov. Siem Reap: Western Prasat Top, Angkor Wats complex, Siem Reap (13°26'N, 103°51'E). On bark of *Dipterocarpus elatus*, elevation about 30 m, 24 November 2010, H. Kashiwadani (50508) & K. H. Moon (TNS–holotype; ABL–isotype).

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*Pyrgillus cambodiensis* is characterized by the yellowish brown thallus without asexual propagules (Fig. 1, A–B), the ostioles and mazaedia with orange-red pigments (Fig. 1, A–C, E), the dark brown, 4-celled spores with distosepta (Fig. 1D), the ascus with uniseriate 8 spores (Fig. 1F) and the absence of xanthones in the thallus.

This species very much resembles *Pyrgillus javanicus* (Mont. & v. d. Bosch) Nyl., a species reported from tropical and subtropical areas in the world (Aptroot 1991, Tibell 1987), in having similar ascocarps with mazaedia and in forming similar ascospores. However, it is clearly

distinguished from the latter by the presence of red pigments (K + purple) in the mazaedia and ostioles and the absence of xanthones in the thallus (UV –); *P. javanicus* has whitish grey ostioles (K –) and produces lichexanthone, showing a dark yellow fluorescence by UV.

*Pyrgillus cambodiensis* grows on bark of big trees such as *Tetrameles* and *Dipterocarpus* along trails in open ground of temple precincts at elevation about 30 m. It is accompanied by several lichens of the genera *Carbocanthographis*, *Dirinaria*, *Graphis*, *Letrovitia*, *Pyxine*, etc.

The species is so far known only from Cambodia.

Other specimens examined. CAMBODIA. Prov. Siem Reap: Around Ta Nei temple, Angkor Wats complex, Siem Reap (13°27'N, 103°53'E), on bark of *Tetrameles nudiflora*, elevation about 30 m, 27 July 2009, H. Kashiwadani 47894; the same locality, on bark, 27 July 2009, H. Kashiwadani 50076.

2) *Tylophoron moderatum* Nyl. in Bot. Zeitung 20: 279 (1862). [Fig. 1, G–K]

This species has been well revised taxonomically by Tibell (1982), being widely distributed in tropical and subtropical areas in the world. In Asia it has been reported from Bangladesh (Alam and Gafur 2008), Formosa (reported under *T. moderatum* subsp. *orientale*, Zahlbruckner 1933) and Papua New Guinea (Tibell 1987), but it has never been reported from Cambodia. The specimens from Cambodia have the following characteristics; a crustose thallus (Figs. 1, G–I), showing negative reaction with C, shortly cylindrical apothecia with mazaedia on the top (Figs. 1, I, J), up to 0.6 mm in diameter, to 0.5 mm high; a thin exciple of up to 35  $\mu\text{m}$  thick; the thalloid exciples showing a red reaction with C; black mazaedia which are often projecting beyond the margin (Fig. 1, J); dark brown 1-septate ascospores with blackish brown zones at the septa and pointed ends, 10–12  $\times$  6–7  $\mu\text{m}$  (Fig. 1, K); and the presence of lecanoric and 2'-methylperlatolic acids. These features coincide well morphologically and chemically with the description given by Tibell (1982) and *exsiccata*

specimens of *T. moderatum* preserved in TNS (Tibell: *Caliciales* Exs. 100 and Vězda: *Lichenes Selecti* Exs. 777).

Among the collection from the present area, three specimens have continuous and whitish gray thallus. In one specimen (HK 50562, Fig. 1, H), however, the thallus is very thin and greenish yellow except for the thalloid exciples which are covered with whitish grey thallus as seen in other specimens. As for the other characteristic features observed in ascocarps and chemistry, no difference are detected. The differences in thallus seems to have no taxonomic value.

In the present area, it grows on bark of *Tetrameles* and *Ficus* along trails of precincts in rather sunny condition with sunshine filtering through foliage. New to Cambodia.

Specimens examined. CAMBODIA. Prov. Siem Reap: Around Ta Prohm temple, Angkor Wats complex, Siem Reap. On bark of *Tetrameles nudiflora*; elevation about 30 m, 10 Dec. 2011, H. Kashiwadani (50345, 50380) & K. H. Moon; the same locality and date, on bark of *Ficus altissima*, H. Kashiwadani (50382, 50562) & K. H. Moon.

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# Literature Cited

- Aptroot A. 1991. A Monograph of the *Pyrenulaceae* (excluding *Anthracotheceum* and *Pyrenula*) and the *Requienellaceae*, with notes on the *Pleomassariaceae*, the *Trypetheliaceae* and *Mycomicrothelia* (Lichenized and non-lichenized *Ascomycetes*). Bibliotheca Lichenologica, Bd. 44. 178 pp. J. Cramer, Berlin.
- Alam N. and Gafur M. A. 2008. Lichen flora in Chandra Sal Forest: Occurrence, distribution and abundance. Bangladesh J. Bot. 37(1): 61–65.
- Kashiwadani H. 2008. Lichenes Minus Cogniti Exsiccati, XV. National Science Museum, Tokyo 1–4.
- Moon K. H., Nakanishi M. and Kashiwadani H. 2011. Studies on Cambodian species of *Graphidaceae* (*Ostropales*, *Ascomycota*) (I). J. Jpn. Bot. 86: 273–278.
- Nakanishi M., Kashiwadani H., Futagami Y. and Moon K.-H. 2010. Nine species of *Graphidaceae* (*Ostropales*, *Ascomycota*) collected in Siem Reap, Cambodia. J. Jpn. Bot. 85: 313–321.
- Tibell L. 1982. *Caliciales* of Costa Rica. Lichenologist 14: 219–254.
- Tibell L. 1987. Australasian *Caliciales*. Symbolae Botanicae Upsaliensis 27(1): 1–279.
- Zahlbruckner A. 1933. Flechten der Insel Formosa. Fedde Repert. 31: 194–224.

柏谷博之<sup>a</sup>, A. Aptroot<sup>b</sup>, 二神葉子<sup>c</sup>, 文光喜<sup>d</sup>: 胞子塊(マゼエチア)を持つカンボジア産地衣類について

筆者等は 2005 年以来カンボジア王国のアンコールワット遺跡周辺に生育する地衣類の分類学的研究を行っているが、胞子塊を持つ粉果地衣類 2 種を発見したので報告する。

1) *Pyrgillus cambodiensis* (アカエントツゴケ, 新称): 地衣体は平滑, 淡褐色で光沢はない。子嚢果は黒色, 円錐台形で上部半分は地衣体上に突出し, 基部は埋まる。頂部には胞子と短い菌糸の集合体からなる胞子塊を形成する。果殻は炭化し, 中程で肥厚するので子嚢果は上下 2 室から構成されている。下部には無色の子嚢層があり, 子嚢は円筒形。胞子は褐色, 4 室で各隔壁は肥厚する。胞子は 1 子嚢中に 8 個, 無色, 4 室, 10–12 × 5–7 μm。地衣体に地衣成分は含まないが, 孔口周辺にアントラキノン系色素を含む。

本種は熱帯から亜熱帯に広く分布する *Pyrgillus javanicus* に酷似しているが, *P. javanicus* は地衣体に

リヘキサントーン (UV+ 黄色) を含み, 孔口の周辺に色素を持たない点で区別できる。カンボジア特産。

2) *Tylophoron moderatum* (コブチイ, 新称): 地衣体は灰白色, 連続するが薄い。子嚢果は短い円柱状, 直径は 0.6 mm, 高さは 0.5 mm ほどで頂部に胞子塊を生じる。果殻は褐色で薄く, 厚さ 30–35 μm。胞子は褐色, 2 室, 10–12 × 6–7 μm, 隔壁部に黒褐色の色素層が太く沈着する。地衣体は C–, 果托は C+ 紅色で主成分としてレカノール酸を含む。

本種は熱帯に広く分布する *T. protrudens* に酷似しているが, 地衣体が C– という点で区別される。カンボジア新産。

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